

What is claimed is:

1. A point diffraction interferometer which measures a profile irregularity of a surface to be measured by, irradiating light irradiated from a light source to a pinhole mirror via a collective optical system, irradiating a part of the light diffracted from a pinhole provided in the pinhole mirror to said surface to be measured as a luminous flux for measurement, making said luminous flux for measurement reflected by the surface to be measured interfere with a reference luminous flux which is an other part of light diffracted from said pinhole, and detecting the state of an interference fringe caused by the interference, wherein

a diameter range of said pinhole is:

$$\lambda/2 \leq \phi \text{ PH} \leq \lambda/\text{NA},$$

wherein λ is a wavelength of light irradiated from said light source, NA is a numerical aperture of said collective optical system, and $\phi \text{ PH}$ is a diameter of said pinhole.

2. A point diffraction interferometer which measures a profile irregularity of a surface to be measured by, irradiating light irradiated from a light source to a pinhole mirror via a collective optical system, irradiating a part of the light diffracted from a pinhole provided in the pinhole mirror to said surface to be measured as a luminous flux for measurement, making said luminous flux for measurement reflected by the surface to be measured interfere with a reference luminous flux which is an other part of light diffracted from said pinhole, and detecting the state of an interference fringe caused by the interference, wherein

a range of a numerical aperture of said collective optical system is:

$$\text{NA} \leq \lambda/\phi \text{ PH},$$

$$0 < \text{NA} < 1,$$

wherein λ is a wavelength of light irradiated from said light source, NA is a numerical aperture of said collective optical system, and $\phi \text{ PH}$ is a diameter of said pinhole.

3. A point diffraction interferometer which measures a profile irregularity of a surface to be measured by, irradiating light irradiated from a light source to a pinhole mirror via a collective optical system, irradiating a part of the light diffracted from a pinhole provided in the pinhole mirror to said surface to be measured as a luminous flux for measurement, making said luminous flux for measurement reflected by the surface to be measured interfere with a reference luminous flux which is an other part of light diffracted from said pinhole, and detecting the state of an interference fringe caused by the interference, wherein the light irradiated onto said pinhole is elliptically polarized light, and

$$0.5 < \varepsilon < 2,$$

wherein ε is ellipticity (ratio of a minor axis to a major axis).

4. A point diffraction interferometer which measures a profile irregularity of a surface to be measured by, irradiating light irradiated from a light source to a pinhole mirror via a collective optical system, irradiating a part of the light diffracted from a pinhole provided in the pinhole mirror to said surface to be measured as a luminous flux for measurement, making said luminous flux for measurement reflected by the surface to be measured interfere with a reference luminous flux which is an other part of light diffracted from said pinhole, and detecting the state of an interference fringe caused by the interference, wherein

said pinhole mirror has a transparent substrate, a first reflection coating and a second reflection coating comprising said pinhole, formed sequentially on this substrate.

5. A point diffraction interferometer according to claim 4, wherein when said pinhole diameter is $0.5 \mu\text{m}$ or larger:

$$0.5 \leq \gamma < 1;$$

$$\phi = \Delta + 360^\circ \times N \quad (-45^\circ \leq \Delta \leq 45^\circ, N = \text{integer}),$$

wherein γ is internal reflectivity of said pinhole (reflection by the first reflection coating) / external reflectivity of said pinhole (reflection by the second reflection coating), and ϕ is a phase difference between the internal reflectivity and the external reflectivity of said pinhole.

6. A point diffraction interferometer which measures a profile irregularity of a surface to be measured by, irradiating light irradiated from a light source to a pinhole mirror via a collective optical system, irradiating a part of the light diffracted from a pinhole provided in the pinhole mirror to said surface to be measured as a luminous flux for measurement, making said luminous flux for measurement reflected by the surface to be measured interfere with a reference luminous flux which is an other part of light diffracted from said pinhole, and detecting the state of an interference fringe caused by the interference, wherein a dielectric multilayer reflection coating is formed on said surface side to be measured of said pinhole mirror.

7. A point diffraction interferometer which measures a profile irregularity of a surface to be measured by, irradiating polarized light irradiated from a light source to a polarization retention fiber, irradiating a part of the polarized light emitted from this fiber to said surface to be measured as a luminous flux for measurement, making said luminous flux for measurement reflected by said surface to be measured interfere with a reference luminous flux which is an other part of polarized light emitted from said fiber, and detecting the state of an interference fringe caused by the interference, wherein

a $\lambda/2$ plate comprising a rotation mechanism is arranged between said light source and the polarization retention fiber.

8. A point diffraction interferometer which measures a profile irregularity of a surface to be measured by, irradiating light irradiated from a light source to a single-mode fiber, irradiating a part of the light emitted from this fiber to the surface to be measured as a luminous flux for measurement, making said luminous flux for measurement reflected by said surface to be measured interfere with a reference luminous flux which is an other part of polarized light emitted from said fiber, and detecting the state of an interference fringe caused by the interference, wherein

a dielectric multilayer reflection coating is formed on an end face on said surface side to be measured of said single-mode fiber.

9. A manufacturing method for a reflecting mirror in which a multilayer film obtained by alternately laminating a heavy element layer and a light element layer on a substrate is formed,

comprising at least a step for measuring a profile irregularity, using a point diffraction interferometer according to any one of claim 1 through claim 8.

10. A projection exposure apparatus comprising an illumination optical system which illuminates a mask by soft X-rays, and a projection optical system which projects a pattern formed on said mask onto a photosensitive substrate for exposure, wherein

said illumination optical system or said projection optical system comprises the reflecting mirror manufactured by the manufacturing method for a reflecting mirror according to claim 9.